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**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
ElectroMagnetic Compatibility (EMC) standard for
2,4 GHz wideband transmission systems and
High PErformance Radio Local Area Network (HIPERLAN)
equipment**

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Foreword

This European Telecommunication Standard (ETS) has been produced by the Electromagnetic compatibility and Radio spectrum Matters (ERM) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 83/189/EEC (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

This ETS, together with ETS 300 328 [1] or ETS 300 836-1 (see bibliography), is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility ("the EMC Directive") (89/336/EEC as amended).

Technical specifications relevant to the EMC Directive are given in annex A.

Transposition dates	
Date of adoption:	24 October 1997
Date of latest announcement of this ETS (doa):	28 February 1998
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1 Scope

This European Telecommunication Standard (ETS) covers the assessment of the 2,4 GHz wideband transmission systems and High Performance Radio Local Area Network (HIPERLAN) equipment in respect of ElectroMagnetic Compatibility (EMC).

This ETS specifies the applicable EMC tests, the method of measurements, the limits and the minimum performance criteria for wideband data communication systems, such as plug-in radio devices, hand-portable equipment, mobile and fixed stations, as specified in ETS 300 328 [1], HIPERLAN Type 1 as specified in ETS 300 652 [2].

In addition to the technical specifications of this ETS, there may be published in the Official Journal of the European Commission references to other Harmonized EMC Standards that apply to the products covered by this ETS in their own right.

The environmental classification used in this ETS refers to the environment classification used in the generic Standards EN 50081-1 [3], EN 50082-1 [4], except the vehicular environment class which refers to ISO 7637, Parts 1 [5] and 2 [6].

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus at residential, commercial, light industrial and vehicular environment. The levels however, do not cover extreme cases which may occur in any location but with low probability of occurrence.

Technical specifications related to the antenna port and emissions for the enclosure port of the equipment are not included in this ETS. Such specific technical specifications are found in the relevant product standard.

This ETS may not cover those cases where a potential source of interference which is producing individually repeated transient phenomena or a continuous phenomena is permanently present, e.g. a radar or broadcast site in the near vicinity. In such a case it may be necessary to use special protection applied to either the source of interference or the interfered part or both.

Compliance of radio equipment to the requirements of this ETS does not signify compliance to any requirements related to spectrum management or any requirement related to the use of the equipment (licensing requirements).

Compliance to this ETS does not signify compliance to any safety requirements. Any observations of equipment becoming dangerous or unsafe as a result of the application of the tests defined in this ETS shall be recorded in the test report.

This ETS is based on the considerations and guidance given in ETR 238 [15].

2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] ETS 300 328: "Radio Equipment and Systems (RES); Wideband transmission systems; Technical characteristics and test conditions for data transmission equipment operating in the 2,4 GHz ISM band and using spread spectrum modulation techniques".
- [2] ETS 300 652: "Radio Equipment and Systems (RES); High Performance Radio Local Area Network (HIPERLAN) Type 1; Functional specification".
- [3] EN 50081-1 (1992): "Electromagnetic compatibility - Generic emission standard - Part 1: Residential, commercial and light industry".

- [4] EN 50082-1 (1992): "Electromagnetic compatibility - Generic immunity standard - Part 1: Residential, commercial and light industry".
- [5] ISO 7637-1 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 1: Passenger cars and light commercial vehicles with nominal 12 V supply voltage - Electrical transient conduction along supply lines only".
- [6] ISO 7637-2 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 2: Commercial vehicles with nominal 24 V supply voltage - Electrical transient conduction along supply lines only".
- [7] EN 55022 (1994): "Limits and methods of measurement of radio disturbance characteristics of information technology equipment".
- [8] CISPR 16-1 (1993): "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus".
- [9] EN 61000-4-3: "Electromagnetic Compatibility (EMC) - Part 4: Testing and measurements techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test".
- [10] EN 61000-4-2 (1995): "Electromagnetic Compatibility (EMC) - Part 4: Testing and measurements techniques - Section 2: Electrostatic discharge immunity test".
- [11] EN 61000-4-4: "Electromagnetic Compatibility (EMC); Part 4: Testing and measurements techniques - Section 4: Electrical fast transient/burst immunity test".
- [12] EN 61000-4-6: "Electromagnetic Compatibility (EMC) - Part 4: Testing and measurements techniques - Section 6: Immunity to conducted disturbances induced by radio-frequency fields".
- [13] EN 61000-4-11: "Electromagnetic Compatibility (EMC); Part 4: Testing and measurements techniques - Section 11: Voltage dips, short interruptions and voltage variations immunity tests".
- [14] EN 61000-4-5: "Electromagnetic Compatibility (EMC) - Part 4: Testing and measurements techniques - Section 5: Surge immunity test".
- [15] ETR 238: "ETSI/CENELEC standardization programme for the development of Harmonized Standards related to Electro-Magnetic Compatibility (EMC) in the field of telecommunications".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETS, the following definitions apply:

enclosure port: The physical boundary of the apparatus through which electromagnetic fields may radiate or impinge.

Equipment Under Test (EUT): Equipment under test and subject to the performance requirements of this ETS.

fixed station: Equipment intended for use in a fixed location and fitted with one or more antennas. The equipment may be fitted with either antenna socket(s) or integral antenna(s) or both.

frequency range: The range of operating frequencies over which the equipment can be adjusted.

hand-portable station: Equipment normally used on a stand-alone basis and to be carried by a person. The equipment may be fitted with one or more antennas. The equipment may be fitted with either antenna socket(s) or integral antenna(s) or both.

host: Any equipment which has complete user functionality when not connected to the radio equipment part and to which the radio equipment part provides additional functionality and to which connection is necessary for the radio equipment part to offer functionality.

manufacturer: The legal entity responsible under the terms of Council Directive 89/336/EEC for placing the product on the market.

mobile station: Equipment normally used in a vehicle or as a transportable station. The equipment may be fitted with one or more antennas. The equipment may be fitted with either antenna socket(s) or integral antenna(s) or both.

operating frequency (operating centre frequency): The nominal frequency at which the equipment can be operated. Equipment may be adjustable for operation at more than one operating frequency.

plug-in radio device: Equipment, including slide-in radio cards, intended to be used with or within a variety of host systems, using their control functions and power supply.

port: A particular interface of the specified equipment (apparatus) with the electromagnetic environment (see figure 1).

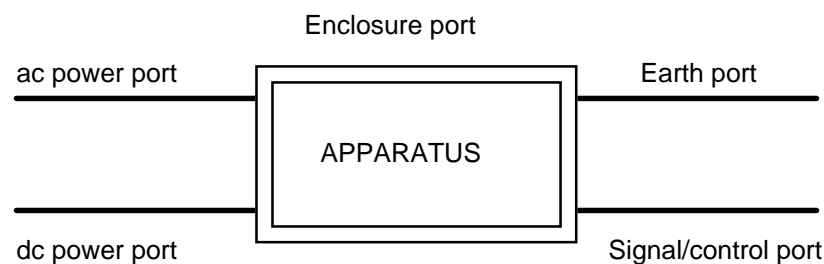


Figure 1: Examples of ports

receiver: A stand alone receiver or the receiver part of a transceiver.

stand-alone radio equipment: Equipment that is intended primarily as communications equipment and that is normally used on a stand-alone basis.

transmitter: A stand alone transmitter or the transmitter part of a transceiver.

3.2 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

ac	alternating current
ACK	ACKnowledgement
ARQ	Automatic Retransmission reQuest
CR	Continuous phenomena applied to Receivers
CT	Continuous phenomena applied to Transmitters
dc	direct current
EMC	ElectroMagnetic Compatibility
EUT	Equipment Under Test
HIPERLAN	High PErformance Radio Local Area Network
LISN	Line Impedance Stabilizing Network
MUS	Maximum Usable Sensitivity
NACK	Not ACKnowledgement
RF	Radio Frequency
rms	root mean square
TR	Transient phenomena applied to Receivers
TT	Transient phenomena applied to Transmitters

4 Test conditions

4.1 General

The equipment shall be tested under conditions which are within the manufacturer's declared range of humidity, temperature, and supply voltage and the actual values of these parameters shall be recorded in the test report.

The radio equipment may take forms which may require special software and/or test fixtures. In all cases the EUT shall be exercised in a manner representative of normal intended use. The test configuration shall be recorded in the test report.

Equipment which requires connection to a host equipment to function shall use the test configuration as defined by the manufacturer.

4.2 Arrangements for test signals at the input of the receiver

4.2.1 General requirements

The test signals required to establish a communications link shall be defined by the manufacturer.

The level of the test signal at the input of the receiver shall be at least 30 dB above the declared Maximum Usable Sensitivity (MUS).

4.2.2 Normal test modulation

The modulated test signal shall represent normal intended use, and may contain data formatting, error detection and correction information.

4.3 Arrangements for test signals at the output of the receiver

It shall be possible to assess the performance of the equipment by appropriately monitoring the receiver output.

4.4 Arrangements for test signals at the input of the transmitter

4.4.1 General requirements

The test signals and/or controls required to establish a communications link shall be defined by the manufacturer. The transmitter shall be operated at maximum rated power.

4.4.2 Normal test modulation

The modulated test signal shall represent normal intended use, and may contain data formatting, error detection and correction information.

4.5 Arrangements for test signals at the output of the transmitter

The measuring equipment used to monitor the output signal of the transmitter shall be located outside the test environment. Adequate measures shall be taken to protect the measuring equipment from the effect of all the radiated fields within the test environment.

The manufacturer may provide a suitable companion receiver that can be used to receive messages or to set up a communication link.

Where the transmitter incorporates an external Radio Frequency (RF) antenna connector, the output signal of the transmitter, shall be coupled to the receiving/measuring equipment via a shielded transmission line such as a coaxial cable. Adequate measures shall be taken to minimize the effect of unwanted common mode currents on the external conductor of the transmission line at its point of entry to the transmitter.

In case of an equipment not provided with an external RF connector, the output signal of the transmitter shall be coupled to another antenna located within the test environment. This antenna shall be coupled to the receiving/measuring equipment outside the test environment.

4.6 Narrow band responses of receivers

Responses of receivers occurring during the test at discrete frequencies which are narrow band responses (spurious responses) are identified by the following method.

If during the test the unwanted signal causes non compliance of the receiver with the specified performance level (see subclause 6.5), it is necessary to establish whether this non compliance is due to a narrow band response or to a wideband phenomenon. Therefore, the unwanted signal frequency is increased by an amount equal to twice the nominal bandwidth of the receiver pre-demodulation filter, as declared by the manufacturer. The test is repeated with the frequency of the unwanted signal decreased by the same amount.

If the receiver is then in compliance with the specified performance level (see subclause 6.5), the response is considered as a narrow band response.

If the receiver still does not comply with the specified performance level (see subclause 6.5), this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrowband response. Under these circumstances the procedure is repeated with the increase and decrease of the frequency of the unwanted signal adjusted two and a half times the bandwidth previously referred to. If the receiver still does not comply with the specified performance level, the phenomena is considered wideband and therefore an EMC problem and the equipment fails the test.

Narrow band responses shall be disregarded.

5 Performance assessment

5.1 Manufacturer declarations

The manufacturer shall supply the following information which shall be recorded in the test report:

- a) the operating frequency range(s) of the equipment and, where applicable, band(s) of operation;
- b) the bandwidth, and the definition thereof, of the pre-demodulation filter;
- c) the type of the equipment, for example: stand-alone or plug-in radio device;
- d) the host equipment to be combined with the radio equipment for testing;
- e) an exhaustive list of ports, classified as either power or signal/control. Power ports shall further be classified as ac (alternating current) or dc (direct current) power;
- f) if applicable, the maximum length(s) of all cables for external connections;
- g) the extreme operating conditions that apply to the equipment offered for testing;
- h) the nominal supply voltages of the stand-alone radio equipment or the nominal supply voltages of the host equipment in case of plug-in devices;
- j) the primary functions of the radio equipment to be evaluated during and after the EMC tests;
- k) the intended functions of the EUT which shall be in accordance with the documentation accompanying the equipment;
- l) the user control functions and stored data that are required for normal operation and the method to be used to assess whether these have been lost after EMC stress;

- m) the minimum performance level under the application of EMC stress (see subclause 6.2);
- n) the normal test modulation, the format, the type of error correction and any control signals e.g. ACKnowledgement (ACK)/Not ACKnowledgement (NACK) or Automatic Retransmission reQuest (ARQ).

5.2 Performance assessment criteria

The performance assessment is based on:

- maintenance of function(s);
- the way the eventual loss of function(s) can be recovered;
- unintentional behaviour of the EUT.

5.3 Additional assessments for hand-portable and mobile equipment

Hand portable equipment, or combinations of equipment, declared as capable of being powered for intended use by the main battery of a vehicle shall additionally be considered as a vehicular mobile equipment.

Hand portable or mobile equipment, or combinations of equipment, declared as capable of being powered for intended use by ac mains shall additionally be considered as fixed station equipment. Where ac power units for such equipment are physically separated from the EUT by leads less than 3 m in length, tests shall be carried out on the ac port of the power supply. Where the lead exceeds 3 m in length, the power port shall be considered as a dc port.

6 Performance criteria

6.1 General performance criteria

The performance criteria are:

- performance criteria A for immunity tests with phenomena of a continuous nature;
- performance criteria B for immunity tests with phenomena of a transient nature;
- performance criteria C for immunity tests with power interruptions exceeding a certain time.

The equipment shall meet the minimum performance criteria as specified in the following subclauses.

6.2 Performance table

Table 1: Performance criteria

Criteria	During test	After test
A	Shall operate as intended. May show degradation of performance (see note 1). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance (see note 2). Shall be no loss of function. Shall be no loss of stored data or user programmable functions.
B	May show loss of function (one or more). May show degradation of performance (see note 1). No unintentional transmissions.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no degradation of performance (see note 2). Shall be no loss of stored data or user programmable functions.
C	May be loss of function (one or more).	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no degradation of performance (see note 2).
NOTE 1:	Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.	
NOTE 2:	No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.	

6.3 Performance criteria for Continuous phenomena applied to Transmitters (CT)

The performance criteria A shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

6.4 Performance criteria for Transient phenomena applied to Transmitters (TT)

The performance criteria B shall apply, except for power interruptions of 5 000 ms duration, for which performance criteria C shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

6.5 Performance criteria for Continuous phenomena applied to Receivers (CR)

The performance criteria A shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

6.6 Performance criteria for Transient phenomena applied to Receivers (TR)

The performance criteria B shall apply, except for power interruptions of 5 000 ms duration for which performance criteria C shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

7 Applicability overview table

Table 2: Emissions and immunity requirements overview

Port	Phenomena	Stand-alone			Plug-in	Reference document
		AC powered	DC powered	Internal battery powered		
Enclosure	RF Electromagnetic field 80 - 1 000 MHz	applicable	applicable	applicable	applicable	EN 61000-4-3 [9]
	Electrostatic Discharge	applicable	applicable	applicable	applicable	EN 61000-4-2 [10]
Antenna port	RF common Mode	applicable	applicable	applicable	applicable	EN 61000-4-6 [12]
Signal and control ports	Fast transients common mode	applicable	applicable	applicable	applicable	EN 61000-4-4 [11]
	RF common mode	applicable	applicable	applicable	applicable	EN 61000-4-6 [12]
	Electrostatic Discharge	applicable	applicable	applicable	applicable	EN 61000-4-2 [10]
DC power input ports	Emissions	not applicable	applicable	not applicable	not applicable	EN 55022 [7] CISPR 16-1 [8]
	Transients and surges	not applicable	applicable	not applicable	not applicable	ISO 7637-1 [5] and ISO 7637-2 [6]
	Fast transients common mode	not applicable	applicable	not applicable	not applicable	EN 61000-4-4 [11]
	RF common mode	not applicable	applicable	not applicable	not applicable	EN 61000-4-6 [12]
AC mains input ports	Emissions	applicable	not applicable	not applicable	not applicable	EN 55022 [7]
	Voltage dips	applicable	not applicable	not applicable	not applicable	EN 61000-4-11 [13]
	Surges, common and differential mode	applicable	not applicable	not applicable	not applicable	EN 61000-4-5 [14]
	Fast transients common mode	applicable	not applicable	not applicable	not applicable	EN 61000-4-4 [11]
	RF common mode	applicable	not applicable	not applicable	not applicable	EN 61000-4-6 [12]

8 Test methods and limits

8.1 Test configuration

This subclause defines the requirements for test configurations for tests in the following subclauses and are as follows:

- measurements shall be made in the operational mode producing the largest emission in the frequency band being investigated consistent with normal applications;
- tests shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and host equipment;
- if the equipment is part of a system, or can be connected to other equipment, then it shall be acceptable to test the equipment while connected to the minimum representative configuration of other equipment necessary to exercise the ports;

- the configuration and mode of operation during measurements shall be recorded in the test report;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of termination are covered;
- ports which in normal operation are connected to other equipment shall be suitably terminated, either directly or via a representative piece of cable terminated to simulate the input impedance of the other equipment. RF input/output ports shall be terminated in a manner defined by the manufacturer.

8.2 Enclosure port

8.2.1 Immunity

8.2.1.1 Radio frequency electromagnetic fields

8.2.1.1.1 Definition

This test assesses the ability of transmitters and receivers to operate as intended in the presence of a radio frequency electromagnetic disturbance on the enclosure port. This test is for radio frequency electromagnetic field disturbance in the range 80 MHz - 1 000 MHz.

8.2.1.1.2 Test method

The test method shall be in accordance with EN 61000-4-3 [9].

The following requirements and evaluation of test results shall apply:

- the test level shall be 3 V/m (measured unmodulated). The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz. In the event of measurement difficulties, a modulating frequency of 400 Hz may be used;
- the test shall be performed over the frequency range 80 MHz - 1 000 MHz, with step frequency increments of 1 % of the momentary frequency.

8.2.1.1.3 Performance criteria

For transmitters the performance criteria CT (see subclause 6.3) shall apply.

For receivers the performance criteria CR (see subclause 6.5) shall apply.

8.2.1.2 Electrostatic discharge

8.2.1.2.1 Definition

This test assesses the ability of equipment to operate as intended in the event of an electrostatic discharge.

8.2.1.2.2 Test method

The test method shall be in accordance with EN 61000-4-2 [10].

The following requirements and evaluation of test results shall apply:

- for contact discharge the EUT shall pass the test at ± 4 kV; for air discharge the equipment shall pass the test at ± 8 kV. Refer to EN 61000-4-2 [10] for all other details including intermediate test levels;
- electrostatic discharges shall be applied to all exposed surfaces of the EUT.

8.2.1.2.3 Performance criteria

For transmitters the performance criteria TT (see subclause 6.4) shall apply.

For receivers the performance criteria TR (see subclause 6.6) shall apply.

8.3 Antenna port

8.3.1 Immunity

8.3.1.1 Radio frequency common mode (current clamp injection)

This test assesses the ability of equipment to operate as intended in the presence of a common mode radio frequency electromagnetic field disturbance at the antenna port.

8.3.1.1.1 Applicability

This test shall be applied only where the antenna port connection consists of a coaxial port which may interface with a cable of length exceeding 3 m.

8.3.1.1.2 Test method

This shall be in accordance with the basic standard EN 61000-4-6 [12]. The current clamp injection method shall be used. The frequency range shall be 150 kHz to 80 MHz.

8.3.1.1.3 Performance criteria

For transmitters the performance criteria CT (see subclause 6.3) shall apply.

For receivers the performance criteria CR (see subclause 6.5) shall apply.

8.4 DC power input/output ports

These tests are applicable for equipment which may have dc cables longer than 3 m.

Equipment with a dc power input port intended to be used with an ac/dc power adaptor shall additionally be tested on the ac power input port of the adaptor in accordance with subclause 8.5.

8.4.1 Emissions

8.4.1.1 Definition

This test assesses the ability of transmitters and receivers to limit their internal noise present on the dc power input/output ports.

8.4.1.2 Test method

The test method shall be in accordance with EN 55022 [7] and the Line Impedance Stabilizing Networks (LISNs) shall be connected to the dc power source.

A measuring receiver shall be connected to each LISN measurement port in turn and the conducted emission recorded. The LISN measurement ports not being used for measurement shall be terminated with a 50 Ω load.

The equipment shall be installed with a ground plane as defined in EN 55022 [7]. The reference earth point of the LISNs shall be connected to the reference ground plane with a conductor as short as possible.

The measurement receiver shall be in accordance with the requirements of part 1 of CISPR 16-1 [8].

8.4.1.3 Limits

The EUT shall meet the limits according to EN 55022 [7], as shown in table 3, including the average limit and the quasi-peak limit when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with the method described in subclause 8.4.1.2. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.

Table 3: Emissions limits: dc power ports

Frequency range	Quasi-peak	Average
0,15 - 0,5 MHz	66 - 56 dB μ V	56 - 46 dB μ V
> 0,5 - 5 MHz	56 dB μ V	46 dB μ V
> 5 - 30 MHz	60 dB μ V	50 dB μ V

NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 MHz to 0,5 MHz.

8.4.2 Immunity

8.4.2.1 Fast transients common mode

8.4.2.1.1 Definition

This test assesses the ability of equipment to operate as intended in the event of fast transients present on one of the dc input/output port(s).

8.4.2.1.2 Test method

The test method shall be in accordance with EN 61000-4-4 [11].

For equipment having cables longer than 3 m, the following requirements and evaluation of test results shall apply:

- the test level for dc power input ports shall be 0,5 kV open circuit;
- for dc power input ports the transients shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground (true common mode). The source impedance shall be 50 Ω .

8.4.2.1.3 Performance criteria

For transmitters the performance criteria TT (see subclause 6.4) shall apply.

For receivers the performance criteria TR (see subclause 6.6) shall apply.

8.4.2.2 Radio frequency common mode

8.4.2.2.1 Definition

This test assesses the ability of equipment to operate as intended in the presence of a radio frequency electromagnetic disturbance on the dc input/output ports. This test substitutes radiated radio frequency electromagnetic immunity testing in the frequency range 150 kHz to 80 MHz.

8.4.2.2.2 Test method

This test may also be performed using the intrusive method, where appropriate, see EN 61000-4-6 [12].

The test method shall be in accordance with EN 61000-4-6 [12].

The following requirements and evaluation of test results shall apply:

- the test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz, except where the wanted signal is 1 kHz. In this case 400 Hz may be used;
- the stepped frequency increments in the frequency range 150 kHz to 5 MHz shall be 50 kHz. For frequencies in the frequency range 5 MHz - 80 MHz, the stepped frequency increment shall be 1 %;
- the test level shall be severity level 2 as given in EN 61000-4-6 [12] corresponding to 3 V rms (measured unmodulated);
- the test shall be performed over the frequency range 150 kHz - 80 MHz;
- to enable the best test method to be used an intrusive or direct connection may be made to any of the lines of the input/output port where it is practical and the performance of the equipment is not degraded. Alternatively the current clamp injection method may be used;
- the test method shall be described in the test report.

8.4.2.2.3 Performance criteria

For transmitters the performance criteria CT (see subclause 6.3) shall apply.

For receivers the performance criteria CR (see subclause 6.5) shall apply.

8.4.2.3 Transients and surges, vehicular environment

These tests are applicable to equipment intended for use in a vehicular environment.

These tests shall be performed on 12 V and 24 V dc power input ports of equipment, intended for vehicular use.

8.4.2.3.1 Definition

These tests assess the ability of equipment to operate as intended in the event of transients and surges present on the dc power input ports in a vehicular environment.

8.4.2.3.2 Test methods and levels

The test method shall be in accordance with ISO 7637-1 [5] for 12 V dc powered equipment and ISO 7637-2 [6] for 24 V dc powered equipment.

8.4.2.3.2.1 Test requirements for 12 V dc powered equipment

Where the manufacturer in his installation documentation requires the EUT to have a direct connection to the 12 V main vehicle battery the requirements in a) shall apply.

Where the manufacturer does not require the EUT to have a direct connection to the 12 V main vehicle battery the requirements in a) and b) shall apply.

- a) requirements when a direct connection to the main vehicle battery is required:
- pulse 3a and 3b, level II, with the test time reduced to 5 minutes for each;
 - pulse 4, level II, 5 pulses, with the characteristics as follows:
 - $V_s = 5\text{ V}$, $V_a = 2,5\text{ V}$, $t_6 = 25\text{ ms}$, $t_8 = 5\text{ s}$, $t_f = 5\text{ ms}$;

- b) additional requirements when a direct connection to the main vehicle battery is not required:
- pulse 1, level II, $t_1 = 2,5\text{ s}$, 10 pulses;
 - pulse 2, level II, $t_1 = 2,5\text{ s}$, 10 pulses.

Where the manufacturer declares that the EUT requires a direct connection to the vehicular battery, and therefore the tests in accordance with the requirements in b) are not carried out, this shall be stated in the test report.

8.4.2.3.2 Test requirements for 24 V dc powered equipment

Where the manufacturer in his installation documentation requires the EUT to have a direct connection to the 24 V main vehicle battery the requirements in c) shall apply.

Where the manufacturer does not require the EUT to have a direct connection to the 24 V main vehicle battery the requirements in c) and d) shall apply.

- c) requirements when a direct connection to the main vehicle battery is required:
- pulse 3a and 3b, level II, with the test time reduced to 5 minutes for each;
 - pulse 4, level II, 5 pulses, with the characteristics as follows:
 - $V_s = 10\text{ V}$, $V_a = 5\text{ V}$, $t_6 = 25\text{ ms}$, $t_8 = 5\text{ s}$, $t_f = 5\text{ ms}$;

- d) additional requirements when a direct connection to the main vehicle battery is not required:
- pulse 1a, level II, $t_1 = 2,5\text{ s}$, $R_i = 25\ \Omega$ 10 pulses;
 - pulse 1b, level II, $t_1 = 2,5\text{ s}$, $R_i = 100\ \Omega$ 10 pulses.

Where the manufacturer declares that the EUT requires a direct connection to the vehicular battery, and therefore the tests in accordance with the requirements in d) are not carried out, this shall be stated in the test report.

Radio and host equipment designed to operate at both dc power voltages shall be tested at both voltages.

8.4.2.3.3 Performance criteria

For transmitters, under the application of pulses 3a and 3b, the performance criteria CT (see subclause 6.3) shall apply. Under the application of pulses 1, 1a, 1b, 2 and 4 the performance criteria TT (see subclause 6.4) shall apply.

For receivers, under the application of pulses 3a and 3b, the performance criteria CR (see subclause 6.5) shall apply. Under the application of pulses 1, 1a, 1b, 2 and 4 the performance criteria TR (see subclause 6.6) shall apply.

8.5 AC mains power input/output ports

These tests shall be performed on ac mains input ports. These tests shall also be performed on any mains output port which is intended to be connected to a cable longer than 3 m.

8.5.1 Emissions

This test is applicable for ac mains powered equipment under test.

8.5.1.1 Definition

This test assesses the ability of equipment to limit its internal noise present on the ac mains power input ports.

8.5.1.2 Test method

The test method shall be in accordance with EN 55022 [7].

8.5.1.3 Limits

The EUT shall meet the limits according to EN 55022 [7] class B, as shown in table 3.

8.5.2 Immunity

8.5.2.1 Fast transients common mode

8.5.2.1.1 Definition

This test assesses the ability of equipment to operate as intended in the event of fast transients present on one of the ac mains input ports.

8.5.2.1.2 Test method

The test method shall be in accordance with EN 61000-4-4 [11]:

- the test level for ac mains power input ports shall be 1 kV open circuit;
- for ac mains power input ports the transients shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground (true common mode). The source impedance shall be 50 Ω .

8.5.2.1.3 Performance criteria

For transmitters the performance criteria TT (see subclause 6.4) shall apply.

For receivers the performance criteria TR (see subclause 6.6) shall apply.

8.5.2.2 Radio frequency common mode

8.5.2.2.1 Definition

This test assesses the ability of equipment to operate as intended in the presence of a radio frequency electromagnetic disturbance on the ac mains power input ports. This test substitutes radiated radio frequency electromagnetic immunity testing in the frequency range 150 kHz to 80 MHz.

8.5.2.2.2 Test method

This test may also be performed using the intrusive method, where appropriate, see EN 61000-4-6 [12].

The test method shall be in accordance with EN 61000-4-6 [12].

The following requirements and evaluation of test results shall apply:

- the test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz, except where the wanted signal is 1 kHz. In this case 400 Hz may be used;
- the stepped frequency increments in the frequency range 150 kHz to 5 MHz shall be 50 kHz. For frequencies in the range 5 MHz - 80 MHz, the stepped frequency increment shall be 1 %;
- the test level shall be severity level 2 as given in EN 61000-4-6 [12] corresponding to 3 V rms (measured unmodulated);
- the test shall be performed over the frequency range 150 kHz - 80 MHz;
- to enable the best test method to be used an intrusive or direct connection can be made to any of the lines of the input/output port where it is practical and the performance of the equipment is not degraded. Alternatively the current clamp injection method may be used;
- the test method shall be described in the test report.

8.5.2.2.3 Performance criteria

For transmitters the performance criteria CT (see subclause 6.3) shall apply.

For receivers the performance criteria CR (see subclause 6.5) shall apply.

8.5.2.3 Voltage dips and interruptions

8.5.2.3.1 Definition

These tests assess the ability of equipment to operate as intended in the event of voltage dips and interruptions present on the ac mains input ports.

8.5.2.3.2 Test method

The following requirements and evaluation of test results shall apply.

The test method shall be in accordance with EN 61000-4-11 [13].

The test levels shall be:

- a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms; and
- a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms; and
- a voltage interruption corresponding to a reduction of the supply voltage of greater than 95 % for 5 000 ms.

8.5.2.3.3 Performance criteria

For a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms the following performance criteria shall apply:

- for transmitters the performance criteria TT (see subclause 6.4);
- for receivers the performance criteria TR (see subclause 6.6).

For a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms the following performance criteria shall apply:

- for transmitters, the performance criteria TT (see subclause 6.4);
- for receivers, the performance criteria TR (see subclause 6.6).

For a voltage interruption corresponding to a reduction of the supply voltage of greater than 95 % for 5 000 ms the following performance criteria shall apply:

- in the case where the equipment is fitted with or connected to a battery back-up, the performance criteria TT (see subclause 6.4 or subclause 6.6) shall apply as appropriate;
- in the case where the equipment is powered solely from the ac mains supply (without the use of a parallel battery back-up) volatile user data may have been lost and if applicable the communication link need not to be maintained and lost functions shall be recoverable by user or operator;
- no unintentional responses shall occur at the end of the test.

In the event of loss of function(s) or in the event of loss of user data, this fact shall be recorded in the test report, the product description and the user documentation.

8.5.2.4 Surges common and differential mode

8.5.2.4.1 Definition

These tests assess the ability of equipment to operate as intended in the event of surges present on the ac mains power input ports.

8.5.2.4.2 Test method

The following requirements and evaluation of test results shall apply.

The test method shall be in accordance with EN 61000-4-5 [14]:

- the test level shall be 1 kV open circuit for common mode and 0,5 kV open circuit for differential mode. Refer to EN 61000-4-5 [14] for all other details including intermediate test levels;
- for common mode tests the surges shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground, (true common mode). Series resistance shall be 10 Ω .

8.5.2.4.3 Performance criteria

For transmitters the performance criteria TT (see subclause 6.4) shall apply.

For receivers the performance criteria TR (see subclause 6.6) shall apply.

8.6 Control and signal ports

8.6.1 Immunity

These tests shall be performed on signal and control ports if the cables may be longer than 3 m.

Where these tests are not carried out on any port because the manufacturer declares that it is not intended to be used with cables longer than 3 m, a list of ports which were not tested for this reason shall be included in the test report.

8.6.1.1 Fast transients common mode

8.6.1.1.1 Definition

This test assesses the ability of equipment to operate as intended in the event of fast transients present on one of the control and signal input/output ports.

8.6.1.1.2 Test method

The test method shall be in accordance with EN 61000-4-4 [11].

For equipment having cables longer than 3 m, the following requirements and evaluation of test results shall apply:

- the test level for signal and control ports shall be 0,5 kV open circuit.

8.6.1.1.3 Performance criteria

For transmitters the performance criteria TT (see subclause 6.4) shall apply.

For receivers the performance criteria TR (see subclause 6.6) shall apply.

8.6.1.2 Radio frequency common mode

8.6.1.2.1 Definition

This test assesses the ability of equipment to operate as intended in the presence of a radio frequency electromagnetic disturbance on the signal and control ports. This test substitutes radiated radio frequency electromagnetic immunity testing in the frequency range 150 kHz to 80 MHz.

8.6.1.2.2 Test method

This test may also be performed using the intrusive method, where appropriate, see EN 61000-4-6 [12].

The test method shall be in accordance with EN 61000-4-6 [12].

The following requirements and evaluation of test results shall apply:

- the test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz, except where the wanted signal is 1 kHz. In this case 400 Hz may be used;
- the stepped frequency increments in the frequency range 150 kHz to 5 MHz shall be 50 kHz. For frequencies in the range 5 MHz - 80 MHz, the stepped frequency increment shall be 1 %;
- the test level shall be severity level 2 as given in EN 61000-4-6 [12] corresponding to 3 V rms (measured unmodulated);
- the test shall be performed over the frequency range 150 kHz - 80 MHz;
- to enable the best test method to be used an intrusive or direct connection may be made to any of the lines of the input/output port where it is practical and the performance of the equipment is not degraded. Alternatively the current clamp injection method may be used;
- the test method shall be described in the test report.

8.6.1.2.3 Performance criteria

For transmitters the performance criteria CT (see subclause 6.3) shall apply.

For receivers the performance criteria CR (see subclause 6.5) shall apply.

8.6.1.3 Electrostatic discharge

8.6.1.3.1 Definition

This test assesses the ability of equipment to operate as intended in the event of an electrostatic discharge on the signal and control ports.

8.6.1.3.2 Test method

The test method shall be in accordance with EN 61000-4-2 [10].

The following requirements and evaluation of test results shall apply:

- for contact discharge the EUT shall pass the test at ± 4 kV; for air discharge the equipment shall pass the test at ± 8 kV. Refer to EN 61000-4-2 [10] for all other details including intermediate test levels;
- electrostatic discharges shall be applied to all exposed surfaces of the signal and control ports except where the user documentation specifically indicates a requirement for appropriate protective measures.

8.6.1.3.3 Performance criteria

For transmitters the performance criteria TT (see subclause 6.4) shall apply.

For receivers the performance criteria TR (see subclause 6.6) shall apply.

9 Interpretation of the measurement results

The interpretation of the test results recorded in a test report for the measurements described in this ETS shall be:

- a) the measured value related to the corresponding limit shall be used to decide whether an equipment meets the requirements of this ETS;
- b) the measurements shall be performed in accordance with the requirements stated in the basic standards.

Annex A (normative): Subclauses of this ETS relevant for compliance with the essential requirements of the EC Council Directives

Table A.1: Subclauses of this ETS relevant for compliance with the essential requirements of EC Council Directives

Clause/subclause number and title		Corresponding article of Council Directive 89/336/EEC	Qualifying remarks
8	Test methods and limits		
8.2	Enclosure port		
8.2.1	Immunity		
8.2.1.1	Radiated electromagnetic fields, 80 MHz - 1 000 MHz	4(b)	
8.2.1.2	Electrostatic discharge	4(b)	
8.3	Antenna port		
8.3.1	Immunity		
8.3.1.1	Radio frequency common mode (current clamp injection)	4(b)	
8.4	DC power input/output ports		
8.4.1	Emissions	4(a)	
8.4.2	Immunity		
8.4.2.1	Fast transients common mode	4(b)	
8.4.2.2	Radio frequency common mode	4(b)	
8.4.2.3	Transients and surges, vehicular environment	4(b)	
8.5	DC mains power in/out		
8.5.1	Emissions	4(a)	
8.5.2	Immunity		
8.5.2.1	Fast transients common mode	4(b)	
8.5.2.2	Radio frequency common mode	4(b)	
8.5.2.3	Voltage dips and interruptions	4(b)	
8.5.2.4	Surges common and differential mode	4(b)	
8.6	Control and signal ports		
8.6.1	Emissions	4(a)	under consideration
8.6.2	Immunity		
8.6.2.1	Fast transients common mode	4(b)	
8.6.2.2	Radio frequency common mode	4(b)	

Annex B (informative): Bibliography

- ETS 300 836-1: "Radio Equipment and Systems (RES); High Performance Radio Local Area Network (HIPERLAN) Type 1 Conformance Testing Specification; Part 1: Radio Type Approval and Radio Frequency (RF) Conformance Test Specification".

History

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